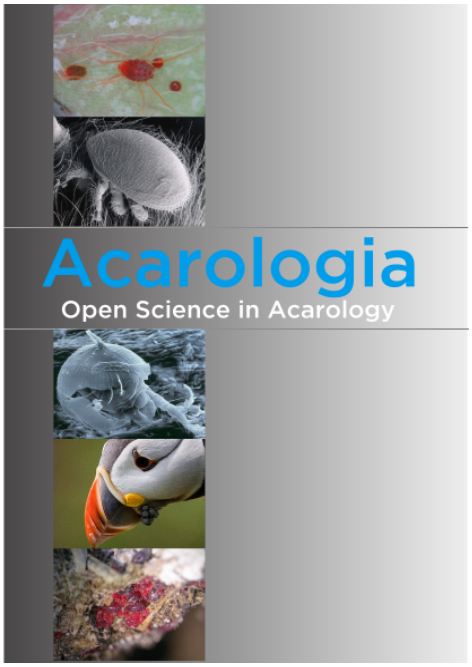

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Previous volumes (2010-2016): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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First records of Phytoseiidae (Acari: Mesostigmata) from one island of the Comoros Archipelago

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ABSTRACT

The Comoros Archipelago is constituted of four islands. These islands are located in the North Mozambique Channel in the Indian Ocean, one of the world's hotspots of biodiversity. Despite this status of hotspot, only one species of Phytoseiidae was known from this Archipelago, from Mayotte: *Phytoseius mayottae*. No species were recorded from the three other main islands. We report in this paper the results of a preliminary survey in Great Comoro or "Grande Comore" Island also called Ngazidja in the Comorian language (= Shikomori) with five species recorded.

Keywords Survey, collection, taxonomy, systematics, Grande Comore
Zoobank http://zoobank.org/BABDD080-D2D0-46F6-8172-442298192D42

Introduction

Several species in the family Phytoseiidae are important natural enemies controlling phytophagous mite and small insects in natural areas and crops all around the world (McMurtry and Croft 1997; McMurtry *et al.* 2013).

This family is widespread all over the world and consists of 2,479 valid species dispatched in three sub-families and 94 genera (Demite *et al.* 2017). Most of areas of the Indian Ocean constitute one of the world's hotspots of biodiversity. The hotspot of biodiversity concept was defined by Myers (1988) in order to identify the most immediately important areas for conservation of biodiversity. These hotspots hold high endemism levels and have lost at least 70% of their original natural vegetation (Myers *et al.* 2000). The characterization of the phytoseiid mite diversity in these areas is thus contributing to this general topic of conservation.

Located in the Indian Ocean in the North of Mozambique Channel, Comoros Archipelago is constitutes of four islands: "Grande Comore" called also Ngazidja in Comorian language (= Shikomori), Moheli called also Mweli, Anjouan called also Nzouani, and Mayotte called also Maoré. The climate of the Comoros Archipelago, south of the Equator, is tropical, with a hot and rainy season from December to April, and a relatively cool and dry season from May to November. The average daily temperature goes from around 27°C in the warmest period (January to April), to around 23°C in the coolest months (July, August and September). The two smaller islands (Mohéli and Anjouan) are covered by hills in the interior, while Grande Comore has the volcano Karthala, 2,360 meters high. This main island is the rainiest. On Mount Karthala, even 5,000 mm of rain / year fall, while the capital Moroni, which is located on the windward side receives 2,700 mm of rain / year. On the Comoros there are numerous tropical ecosystems that are primarily dependent on the altitude. Many kinds of tropical plants can be found, large numbers of which are endemic. Like most islands, the diversity of the local

Received 28 November 2017
Accepted 10 January 2018
Published 01 June 2018

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Academic editor
Marie-Stéphane Tixier

DOI
10.24349/acarologia/20184256

How to cite this article Kreiter S. *et al.* (2018), First records of Phytoseiidae (Acari: Mesostigmata) from one island of the Comoros Archipelago. **Acarologia 58(3): 529-545; DOI 10.24349/acarologia/20184256**

flora suffers from two pressures, on one hand the reduction of available space caused by the reduction of biotopes due to the invasion of humans in wildest areas and on the other hand, the invasion of exotic plant species such as guava trees.

Presently, only one species of Phytoseiidae is known from this part of the world, from Mayotte: *Phytoseius mayottae* Schicha. This species was collected by Jean Gutierrez and described by Schicha (1984). No species are recorded from the three other islands.

We report in this paper result of a preliminary survey in Grande Comore Island (Ngazidja).

Material and methods

The survey took place in "Grande Comore" (or Ngazidja) in February 2017. Plant inhabiting mites were collected for this preliminary survey only from various crops in two locations. Mites were directly collected from leaves with a fine brush and then transferred into small plastic vials containing 70% and 98% ethanol. Plant species were identified by Jacques Fillâtre (Armeflhor).

Mites in vials with 70% ethanol were then all mounted on slides using Hoyer's medium and all identified using a phase and interferential contrast microscope (Leica DMLB, Leica Microsystèmes SAS, Nanterre, France). Mites in vials with 98% ethanol will be used for barcoding (in progress).

Morphological characters were measured using a graduate eyepiece (Leica, see above). Chant and McMurtry's (1994, 2007) concepts of the taxonomy for the family Phytoseiidae and the world catalogue database of Demite *et al.* (2017) were used for faunistical and biogeographical aspects. The chaetotaxy terminologies used in this paper followed those proposed by Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978) for Phytoseiidae for dorsal and by Chant and Yoshida-Shaul (1991) for ventral idiosomal setae, respectively. Adenotaxy and poroidotaxy terminologies are those proposed by Athias-Henriot (1975).

Numbers of teeth on the fixed and movable cheliceral digits do not include the respective apical teeth. Setae not referred to in the Results section should be considered as absent.

All measurements are given in micrometers (μm) and presented as the mean in bold followed by the range in parenthesis. All individuals collected were measured.

Specimens of each species are deposited in the mite collections of Montpellier SupAgro conserved in UMR CBGP INRA/IRD/CIRAD/SupAgro.

The following abbreviations are used in this paper for morphological characters: **dsl** = dorsal shield length; **dsw** = dorsal shield width; **lisl** = Largest inguinal sigilla (= "metapodal plate") length; **lisw** = Largest inguinal sigilla (= "metapodal plate") width; **sisl** = smallest inguinal sigilla(= "metapodal plate") length; **vsl** = ventrianal shield length (or ventral shield length for *Iphiseisus degenerans*); **asl** = anal shield length; **vsw ZV2 and vsw anus** = ventrianal shield width at *ZV2* level and at anus level; **scl** = spermatheca cervix length; **scw** = spermatheca cervix width; **fdl** = fixed digit length; **mdl** = movable digit length.

The following abbreviations are used in this paper for institutions: **Armeflhor** = Association Réunionnaise pour la Modernisation de l'Economie Fruitière, Légumière et HORticole; **CBGP** = Centre de Biologie pour la Gestion des Populations; **CIRAD** = Centre International de Recherche Agronomique pour le Développement; **INRA** = Institut National de la Recherche Agronomique; **INRAPE** = Institut National de Recherche pour l'Agriculture, la Pêche et l'Environnement; **IRD** = Institut de Recherche pour le Développement; **MSA** = Montpellier SupAgro, France; **UMR** = Unité Mixte de Recherche; **UPR** = Unité Propre de Recherche.

Results and discussion

A total of five species have been collected and identified, four species of the sub-family Amblyseiinae and one species of the sub-family Phytoseiinae. Three of them are biological control agents, may have great interest for agriculture of this part of the world and some data from the literature are provided here.

Subfamily Amblyseiinae Muma

Amblyseiinae Muma, 1961: 273.

Tribe Amblyseiini Muma

Amblyseiini, Muma, 1961: 68.

Subtribe Amblyseiina Muma

Amblyseiina Muma, 1961: 69.

Genus *Amblyseius* Berlese

Amblyseius Berlese, 1914: 143.

Amblyseius herbicolus (Chant)

Typhlodromus (*Amblyseius*) *herbicolus* Chant, 1959: 84;
Amblyseius (*Amblyseius*) *herbicolus*, Muma 1961: 287;
Typhlodromus herbicolus, Hirschmann, 1962: 23;
Amblyseius herbicolus, Moraes *et al.*, 1986: 14; 1989: 79; 2004: 27; Chant & McMurtry, 2004: 209; 2007: 78;
Amblyseius deleoni Muma & Denmark, 1970: 68 (synonymy according to Daneshvar & Denmark, 1982; Denmark & Muma 1989);
Amblyseius giganticus Gupta, 1981: 33 (synonymy according to Gupta, 1986);
Amblyseius impactus Chaudhri, 1968, 553 (synonymy according to Daneshvar & Denmark, 1982; Denmark & Muma, 1989);
Amblyseius (*Amblyseialus*) *thermophilus* Karg, 1991: 12 (synonymy according to El-Banhawy & Knapp, 2011 and to Demite *et al.*, 2017);
Typhlodromus (*Amblyseius*) *amitae* Bhattacharyya, 1968: 677 (synonymy according to Denmark & Muma, 1989).

Amblyseius herbicolus (Chant) is the second most abundant phytoseiid mites on coffee plants (*Coffea arabica* L.) in Brazil, associated with *Brevipalpus phoenicis* (Geijskes) (Acari: Tenuipalpidae), vector of the coffee ring spot virus. *Amblyseius herbicolus* was found to be an efficient predator of the coffee ring spot mite (Reis *et al.* 2007).

Amblyseius herbicolus is also found associated with the broad mite, *Polyphagotarsonemus latus* Banks in crops such as chili pepper (*Capsicum annuum* L.) in Brazil. This species has also a good potential for controlling *P. latus*. RodrÍguez-Cruz *et al.* (2013) have studied biological, reproductive and life table parameters of *A. herbicolus* on three different diets: broad mites, castor bean pollen (*Ricinus communis* L.) and sunn hemp pollen (*Crotalaria juncea* L.). The predator was able to develop and reproduce on all these three diets. However, its intrinsic growth rate was higher on broad mites and castor bean pollen. Feeding on alternative food such as pollen can facilitate the predator's mass rearing and maintain its population on crops when prey is absent or scarce. Many polyphagous generalist phytoseiid mites are important natural enemies because they can feed on plant provided pollen and various prey species, and thus persist in crops even in the absence of target pests (McMurtry *et al.* 2013). Hence, populations

of these predators can be established in a crop by providing alternative food, thus increasing biological control. Alternative food affects *P. latus* control on chilli pepper plants by predatory mites (Duarte *et al.* 2015). *Amblyseius herbicolus* had high oviposition and population growth rates when fed with cattail pollen (*Typha latifolia* L.), chilli pepper pollen and bee-collected pollen, and a low rate on the alternative prey *Tetranychus urticae* Koch. Supplementing pepper plants with pollen resulted in better control of broad mite populations (Duarte *et al.* 2015). Release of *A. herbicolus* on young plants with weekly addition of honeybee pollen or cattail pollen until plants produce flowers seems a viable strategy to sustain populations of this predator (Duarte *et al.* 2015).

Specimens examined — **Moroni**, Adoudja (long. 11°41′S, lat. 43°15′E, alt. 100 m), 1 ♀ + 1 immature on *Alocasia macrorrhiza* (L.) G. Don (Araceae), 2-02-2017; 1 ♀ + 2 immatures on *Morinda citrifolia* L. (Rubiaceae), 2-02-2017.

Previous record — Large distribution worldwide. This species is mentioned from Mozambique, La Réunion Island, Kenya, Tanzania for the closest places.

Remarks (Table 1) — Measurements of the two females collected fit very well with the measurements reported literature, except for greater dimension of the ventrianal shield and a longer spermatheca for specimens from Grande Comore.

Tribe Euseiini Chant and McMurtry

Euseiini Chant & McMurtry, 2005b: 191.

Subtribe Euseiina Chant and McMurtry

Euseiina Chant & McMurtry, 2005b: 209.

Genus *Euseius* Wainstein

Amblyseius (*Amblyseius*) section *Euseius*, Wainstein, 1962: 15; *Euseius* De Leon, 1967: 86.

Euseius baetae (Meyer & Rodrigues)

Amblyseius baetae (Meyer & Rodrigues, 1966): 28;
Euseius baetae (Meyer & Rodrigues), Moraes *et al.*, 2001a: 11; Moraes *et al.*, 1986: 37; 2004: 62; Chant & McMurtry 2005b: 215; 2007: 120; El Banhawy & Knapp, 2011: 36;
Euseius kangwanensis Ueckermann & Loots , 1988: 85 (synonym according to Ueckermann & Loots, 1988; Moraes *et al.*, 2001b; El-Banhawy & Knapp, 2011).

The 200 species of the genus *Euseius* are considered as Type IV species, polliniphagous generalists (McMurtry and Croft 1997; McMurtry *et al.* 2013) and *Euseius baetae* is supposed to belong to that Type IV. The biology of *E. baetae* is however totally unknown.

Specimens examined — **Mdé**, INRAPE (long. 11°41′S, lat. 43°14′E, alt. 50 m), 1 ♀ on *Manihot esculenta* Crantz (Euphorbiaceae), 2-02-2017; **Moroni**, Adoudja (long. 11°41′S, lat. 43°15′E, alt. 100 m), 2 ♀♀ on *Plectranthus scutellarioides* (L.) R.Br. (Lamiaceae), 2-02-2017; 1 ♀ on *Alocasia macrorrhizos* (L.) G.Don (Araceae), 2-02-2017.

Previous record — Congo, Kenya, Malawi, Mozambique, South Africa.

Remarks (Table 2) — Measurements of the 4 ♀♀ fit well with the measurements from the literature with slightly shorter dimensions in general.

Table 1 Comparisons of character measurements of female specimens of *Amblyseius herbicolus* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	Grande Comore (2)	Kenya (10)	Various countries (8)	Senegal (2)	Turkey (3)	Holotype (1)
Dsl	**385-428**	335	353 (325-368)	360-365	313-352	369
Dsw	**263-275**	190	256 (240-274)	250-268	196-221	236
j1	**40-43**	32	37 (34-40)	35-38	33-38	38
j3	**53-55**	37	49 (38-58)	38-45	32-39	42
j4	**6**	4-6	6 (5-8)	6-8	8-9	9
j5	**5**	4-6	4 (3-5)	4	7-8	7
j6	**5-6**	4-6	7 (5-8)	8	6-7	11
J2	**8-10**	4-6	10 (8-11)	8-9	8-9	12
J5	**10**	4-6	8 (6-10)	8-10	9-10	9
z2	**6-8**	6	11 (8-16)	8-9	9-12	13
z4	**8**	6	8 (8-10)	10-11	8-12	9
z5	**5**	6	6 (5-6)	7-9	6-7	6
Z1	**8**	10	10 (8-13)	8-10	9-12	9
Z4	**133-135**	90	126 (101-152)	163-172	91-99	110
Z5	**288-300**	232	281 (251-306)	310-345	220-251	236
s4	**120-125**	92	113 (98-130)	123-135	86-96	100
S2	**13**	10	12 (8-14)	13-15	10-12	11
S4	**13**	10	11 (8-13)	8-10	9-11	13
S5	**13**	10	9 (8-10)	8-10	9-10	11
r3	**8-15**	10	14 (11-16)	10-11	10-16	15
R1	**10-13**	10	9 (8-10)	9-10	8-9	8
st1-st1	**68**	nr	not reported	nr	nr	nr
st1-st3	**73-75**	62	65 (58-70)	63-65	64-69	
st2-st2	**73-75**	69	71 (66-75)	75-78	70-73	
st3-st3	**63-65**	nr	not reported	nr	nr	nr
st4-st4	**78-83**	nr	not reported	nr	nr	nr
st5-st5	**70-78**	nr	71 (67-75)	65-70	58-64	
lisl	**23**	nr	not reported	nr	nr	nr
lsiw	**5**	nr	not reported	nr	nr	nr
sisl	**13**	nr	not reported	nr	nr	nr
vsl	**120-135**	108	116 (112-118)	113-115	102-117	nr
vsw *ZV2*	**63**	48	57 (53-59)	65-69	44-48	nr
vsw anus	**80**	69	71 (66-77)	75-78	61-69	nr
JV5	**80-85**	52	not reported	nr	51-60	nr
SgeI	**45-48**	nr	42 (35-48)	43-48	40-48	nr
SgeII	**38**	52	38 (35-42	38-40	34-39	nr
SgeIII	**53-58**	41	52 (45-59)	48-52	41-46	nr
StiIII	**43**	35	41 (34-48)	43-45	33-40	nr
SgeIV	**135**	110	124 (96-158)	160-162	98-128	112
StiIV	**100**	76	90 (67-109)	102-15	75-89	82
StIV	**80**	65	76 (66-86)	76-78	63-70	76
scl	**38-40**	nr	32 (32-35)	33-35	24-32	18
scw	**2-3**	nr	not reported	nr	nr	nr
Fdl	**33**	nr	31 (30-31)	nr	29-36	nr
teeth	***11-12***	*8*	*10*		*12*	*11-12*
Mdl	**30**	nr	35 (34-35)	nr	31-33	nr
teeth	***?***	*3*	*3*		*4*	*4*

Data from this study for Grande Comore, from El-Banhawy and Knapp (2011) for Kenya, from Zannou *et al.* (2007) for various countries of Africa (Benin 1, Burundi 1, Democratic Republic of Congo 1, Ghana 1, Kenya 3, Rwanda 1), from Kade *et al.* (2011) for Senegal, fom Akyasi *et al.* (2016) for Turkey, from Denmark and Muma (1989) for the holotype intercepted in Massachusetts (Boston) but coming from Portugal. nr = not reported.

Table 2 Comparisons of character measurements of female specimens of *Euseius baetae* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	Grande Comore (4)	Mozambique (4)	South Africa (7)	Congo (1)	Kenya (1)
Dsl	**341** (310-375)	322-336	337 (343-359)	336	300
Dsw	**329** (220-238)	201-243	252 (224-239)	230	210
j1	**28**	29-38	32 (28-32)	29	21
j3	**8** (6-10)	11-12	9 (8-11)	16	25
j4	**6** (5-8)	9-10	9 (8-11)	11	12
j5	**7** (6-8)	9	9 (8-11)	11	12
j6	**8** (6-8)	10-11	9 (8-11)	16	12
J2	**9** (8-10)	12-13	11 (11-13)	13	13
J5	**7** (5-8)	7-9	6	8	7
z2	**9** (8-10)	11-12	9 (8-11)	14	14
z4	**9** (8-10)	11-12	9 (8-11)	13	20
z5	**7** (5-8)	9-10	9 (8-11)	11	12
Z1	**9** (9-10)	10-12	9 (8-11)	11	12
Z4	**10**	11-14	11 (11-13)	16	15
Z5	**59** (55-65)	59-65	55 (55-60)	53	50
s4	**14** (13-14)	16-20	16 (16-19)	21	30
S2	**9** (8-10)	12-14	11 (11-13)	14	16
S4	**10** (9-10)	12-16	11 (11-13)	14	16
S5	**9** (8-10)	11-13	11 (11-13)	14	14
r3	**14** (13-15)	not reported	13 (13-16)	19	14
R1	**9** (8-10)	not reported	9	11	14
St1-St1	**57** (55-58)	not reported	not reported	nr	nr
St1-St3	**58** (55-60)	77-86	88 (82-91)	58	58
St2-St2	**67** (65-68)	not reported	not reported	70	70
St3-St3	**74** (70-78)	71-78	95 (91-101)	nr	nr
St4-St4	**79** (78-80)	not reported	not reported	nr	nr
St5-St5	**72** (68-75)	not reported	88 (82-91)	74	80
Lisl	**26** (25-28)	not reported	not reported	nr	nr
Lsiw	**2**	not reported	not reported	nr	nr
Sisl	**10** (8-13)	not reported	not reported	nr	nr
Vsl	**91** (78-100)	95-108	88 (82-91)	?	100
vsw *ZV2*	**49** (45-50)	69	69 (69-76)	48	?
Vsw anus	**71** (70-73)	not reported	not reported	67	70
JV5	**39** (38-40)	not reported	38 (38-47)	nr	37
SgeI	**22** (20-25)	not reported	28	nr	nr
SgeII	**27** (25-28)	not reported	32 (32-35)	29	25
SgeIII	**35**	not reported	38 (41-44)	38	30
StiIII	**27** (25-28)	not reported	32 (32-35)	29	nr
SgeIV	**57** (55-58)	64-72	72 (63-72)	56	58
StiIV	**38**	40-47	41 (44-47)	38	51
StIV	**67** (65-68)	71-80	76 (76-79)	70	95
scl	**15**	16-18	not reported	19	24
scw	**5**	not reported	not reported	nr	5
Fdl	**25**	not reported	nr	nr	nr
teeth	***invisible***		***6***		***4***
Mdl	**24** (23-25)	not reported	nr	nr	nr
teeth	***invisible***		***2***		***2***

Data from this study for Grande Comore, from Meyer and Rodrigues (1966) for Mozambique holotype + paratype females, from Ueckermann and Loots (1988) for South Africa (measurements for holotype and between brackets for 6 paratype females), from Moraes *et al.* (2001b) for Congo and from El-Banhawy and Knapp (2011) for Kenya. nr = not reported.

Genus *Iphiseius* Berlese

Iphiseius Berlese, 1916: 33; Chant & McMurtry, 2005b: 217; 2007: 123.

Iphiseius degenerans (Berlese)

Seius degenerans (Berlese, 1889): 9;
Amblyseius (*Iphiseius*) *degenerans*, Muma, 1961: 288;
Typhlodromus degenerans, Hirschmann, 1962: 2;
Iphiseius (*Iphiseius*) *degenerans*, Pritchard & Baker 1962: 299;
Amblyseius degenerans, Zaher, 1986: 99; Northcraft, 1987: 521; Papadoulis & Emmanouel, 1991: 36;
Iphiseius degenerans, Berlese, 1921: 95; Evans, 1954: 518; Moraes *et al.*, 1986: 61; 2004: 92; Chant & McMurtry, 2005b: 215; 2007: 125;
Iphiseius martigellus El-Badry, 1968: 325 (synonymy according to Chant & McMurtry, 2005; El-Banhawy & Knapp, 2011).

The biological characteristics of this Ethiopian species have been well documented because of its use in controlling thrips on various cultivated plants in greenhouses. *Iphiseius degenerans* is a commercially available biological control agent of thrips and spider mites in greenhouse crops. It is able to feed on a variety of foods, but thrips' larvae and sweet pepper pollen are unfavourable food for immature development. This could compromise the establishment of this biological control agent when used against thrips in sweet pepper crops. According to the classification by McMurtry *et al.* (2013), *I. degenerans* is a type-III generalist predator. It is one of the most common native phytoseiid mite species on cassava in southern Africa (Zannou *et al.* 2005) and feeds on *Mononychellus tanajoa* (Bondar) (Nwilene and Nachman 1996), a widely distributed neotropical mite pest of cassava in Africa, insect larvae and pollen of many plants (Vantornhout *et al.* 2005).

Another study concluded that *I. degenerans* can be considered a suitable biological control candidate based on its preference for *Eutetranychus orientalis* nec (Klein) in the Mediterranean region (Fantinou *et al.* 2012).

Iphiseius degenerans preys on *Oligonychus perseae* Tuttle, Baker & Abbatiello outside the webbed nests. Although *I. degenerans* contribution to *O. perseae* biocontrol can be limited, it needs to be assessed, also taking into account the importance of alternative food source (e.g. Castor oil pollen) for predator population growth (Zappala *et al.* 2015).

Specimens examined — **Mdé**, INRAPE (long. 11°41′S, lat. 43°14′E, alt. 50 m), 7 ♀♀ + 4 ♂♂ on *Ricinus communis* L. (Euphorbiaceae), 2-02-2017.

Previous record — Numerous countries in Northern and Southern Africa (Demite *et al.* 2017), in Mediterranean area (Cyprus, Greece, Italy, Portugal), in Near East or Middle East (Egypt, Israel, Lebanon, Saudi Arabia, Syria, Turkey, Yemen), in Europe (Georgia), in South America (Brazil) and in North America (USA in California, Florida, Georgia, New Hampshire).

Remarks (Tables 3 and 4) — Measurements of the 7 ♀♀ + 4 ♂♂ fit well with measurements of specimens reported in the literature for closest countries, except width of the ventral and the anal shields of the female and *JV5* which is more than 40 % longer.

Table 3 Comparisons of character measurements of female specimens of *Iphiseius degenerans* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	Grande Comore (7)	Kenya (66)	Various countries (12)
Dsl	**420** (370-462)	360	373 (363-387)
Dsw	**362** (350-375)	345	309 (290-317)
j1	**24** (20-25)	23	24 (14-32)
j3	**5**	Not reported	5 (4-8)
j4	**5**	Not reported	4 (3-6)
j5	**5**	Not reported	4 (3-5)
j6	**5**	Not reported	5 (4-6)
J2	**5**	Not reported	6 (4-7)
J5	**5**	Not reported	6 (5-7)
z2	**5**	Not reported	5 (4-8)
z4	**5**	Not reported	5 (4-9)
z5	**5**	Not reported	4 (3-5)
Z1	**5**	Not reported	6 (5-8)
Z4	**8** (6-9)	Not reported	7 (5-9)
Z5	**14** (11-15)	12	14 (11-20)
s4	**8**	Not reported	9 (7-12)
S2	**8**	Not reported	8 (6-9)
S4	**9** (8-9)	Not reported	9 (6-11)
S5	**9** (8-9)	Not reported	9 (7-11)
r3	**14** (13-15)	Not reported	12 (10-13)
R1	**11** (9-13)	Not reported	9 (7-10)
St1-St1	**57** (55-60)	Not reported	Not reported
St1-St3	**54** (53-55)	46	49 (42-52)
St2-St2	**71** (68-75)	64	71 (67-73)
St3-St3	**86** (65-93)	Not reported	Not reported
St4-St4	**96** (90-100)	Not reported	Not reported
St5-St5	**96** (90-103)	100	96 (91-103)
Lisl	**36** (30-38)	Not reported	Not reported
Lsiw	**5** (4-8)	Not reported	Not reported
Sisl	**14** (13-18)	Not reported	Not reported
Vsl	**35** (33-38)	Not reported	Not reported
vsw *ZV2*	**77** (70-83)	74	65 (58-73)
Asl	**72** (68-75)	Not reported	Not reported
Vsw anus	**77** (70-83)	Not reported	72 (68-77)
JV5	**24** (20-25)	14	Not reported
SgeII	**24** (21-25)	23	Not reported
SgeIII	**30** (28-33)	35	Not reported
StiIII	**25** (25-26)	Not reported	Not reported
SgeIV	**43** (40-50)	30	Not reported
StiIV	**29** (25-33)	25	Not reported
StIV	**32** (30-33)	38	Not reported
Scl	Not reported	Not reported	Not reported
Scw	Not reported	Not reported	Not reported
Fdl	**27** (25-30)	Not reported	26 (24-27)
teeth	***7***		***6-8***
Mdl	**25** (23-27)	Not reported	31 (27-35)
teeth	***1***		***1-2***

Data from this study for Grande Comore, from El-Banhawy and Knapp (2011) for Kenya, from Moraes *et al.* (2007) for various countries (Burundi 1, Cameroon 1, Ghana 1, Kenya 2, Malawi 2, Rwanda 1, Sierra Leone 2, Uganda 1, Zambia 1) in Africa. nr = not reported.

Table 4 Comparisons of character measurements of male specimens of *Iphiseius degenerans* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	Grande Comore (4)	Kenya (?)	Various countries (5)
Dsl	**306** (295-312)	Not reported	318 (283-356)
Dsw	**232** (238-250)	Not reported	255 (244-261)
j1	**21** (18-23)	Not reported	20 (11-25)
j3	**5**	Not reported	5 (4-5)
j4	**5**	Not reported	3 (3-5)
j5	**5**	Not reported	4 (4-5)
j6	**5**	Not reported	4 (3-4)
J5	**5**	Not reported	5 (4-6)
z2	**5**	Not reported	4 (3-5)
z4	**5**	Not reported	4 (3-5)
z5	**5**	Not reported	3 (3-4)
Z1	**5**	Not reported	5
Z4	**8**	Not reported	5 (4-5)
Z5	**14** (13-15)	Not reported	13 (9-16)
s4	**5**	Not reported	7 (6-9)
S2	**7**	Not reported	6 (5-7)
S4	**7**	Not reported	6 (5-8)
S5	**7**	Not reported	7 (5-10)
r3	**12** (10-13)	Not reported	11 (10-12)
R1	**6** (5-9)	Not reported	7 (6-9)
St1-St1	**49** (48-50)	Not reported	Not reported
St1-St5	**114** (110-118)	Not reported	Not reported
St2-St2	**62** (60-63)	Not reported	Not reported
St3-St3	**64** (60-68)	Not reported	Not reported
St4-St4	**60** (58-63)	Not reported	Not reported
St5-St5	**52** (48-58)	Not reported	Not reported
Vsl	**71** (68-73)	Not reported	Not reported
vsw *ZV2*	**171** (165-175)	210	176 (172-179)
Asl	**51** (48-55)	Not reported	Not reported
Asw	**64** (58-68)	75	66 (63-75)
JV5	**22** (20-23)	Not reported	Not reported
SgeII	**21** (18-25)	Not reported	21 (18-24)
SgeIII	**29** (28-30)	Not reported	27 (21-32)
StiIII	**24** (23-25)	Not reported	21 (20-24)
SgeIV	**42** (40-43)	Not reported	36 (30-40)
StiIV	**30** (28-30)	Not reported	28 (27-30)
StIV	**31** (30-33)	Not reported	28 (26-32)
Shaft length	**24** (23-25)	22	29 (22-45)
Fdl	**23** (20-25)	Not reported	Not reported
teeth	***4***		
Mdl	**22** (20-23)	Not reported	Not reported
teeth	***1***		

Data from this study for Grande Comore, from El-Banhawy and Knapp (2011) for Kenya, from Moraes *et al.* (2007) for various countries (Ghana 1, Kenya 1, Rwanda 1, Sierra Leone1, Uganda 1) in Africa. nr = not reported.

Tribe Neoseiulini Chant and McMurtry

Neoseiulini Chant & McMurtry, 2003a: 6.

Genus *Neoseiulus* Hughes

Neoseiulus Hughes, 1948: 141.

Neoseiulus longispinosus (Evans)

Typhlodromus longispinosus Evans, 1952: 413; Evans, 1953: 465; Womersley, 1954: 177; Ehara, 1958: 55;
Typhlodromus (*Amblyseius*) *longispinosus*, Chant, 1959: 74;
Amblyseius longispinosus, Corpuz and Rimando, 1966: 129; Schicha, 1975: 103;
Neoseiulus longispinosus, Moraes *et al.*, 1986: 85; 2000: 245; 2004: 129; Chant & McMurtry 2003a: 37; 2007: 29.

This species is distributed in many countries of the world, mainly in tropical areas, especially in Guadeloupe and other Islands of the French Antilles (Moraes *et al.* 2000; Mailloux *et al.* 2010; Kreiter *et al.* 2013; Kreiter *et al.* in press).

Neoseiulus longispinosus, a type II phytoseiid predatory mite (McMurtry *et al.* 2013), has received increasing attention in Asia for the control of spider mites since 2010 (Nusartlert *et al.* 2011). It can develop on different tetranychid species of the genera *Eutetranychus*, *Oligonychus*, and *Tetranychus* (Nusartlert *et al.* 2011). Several studies demonstrated the potential of the predatory mite to control spider mite outbreaks including *Oligonychus coffeae* (Nietner) on tea (Rahman *et al.* 2013), *Stigmaeopsis nanjingensis* (Ma & Yuan) on bamboo in China (Zhang *et al.* 1999) or *Eotetranychus cendanai* Rimando in greenhouse crops (Thongtab *et al.* 2001). In addition, *N. longispinosus* was also found to have a great potential for practical applications due to its resistance or tolerance to agricultural chemicals (Zhang *et al.* 1996).

Thus, the biology of this species has been studied mostly for pest control purposes including side effects of miticides (Bin Ibrahim and Tan 2000). The activity, feeding, development, predation, cannibalism, intra-guild predation and behaviour have been extensively studied by several authors (Croft *et al.* 1999a, b; Schausberger and Croft 1999a, b; 2000a, b; Blackwood *et al.* 2001). It was found very rarely in Mascareignes area except in a study on companion plants in citrus orchards in La Réunion (Le Bellec, unpublished data). This species seems to be more common on grasses of the lower vegetation, especially Fabaceae with populations of tetranychid mites. However, the recent results of Huyen *et al.* (2017) show that at least in controlled laboratory conditions the predatory mite *N. longispinosus* is a potential biological control agent against the citrus red spider mite *P. citri.*

Previous Records — Australia, China (Fujian, Guangdong, Guangxi, Hainan, Yunnan), Cuba, Dominican Republic, Guadeloupe, Egypt, Hawaii, Hong-Kong, India, Indonesia, Japan, Les Saintes, Malaysia, Marie-Galante, Martinique, New Zealand, Nicaragua, Pakistan, Papua New Guinea, Philippines, Russia, South Korea, Sri Lanka, Taiwan, Thailand, USA (Florida), Vietnam.

Specimens examined — **Moroni**, Adoudja (long. 11°41′S, lat. 43°15′E, alt. 100 m), 1 ♀ on *Plectranthus scutellarioides* (L.) R. Br. (Lamiaceae), 2-02-2017.

Remarks (Table 5) — Measurements of the single female collected show that most of the setae lengths are 7 to 15 % longer, except *j6*, *J2*, *J5*, and *Z4*. All ventral, spermathecal and cheliceral dimensions agree well except ventrianal shield length and width at the level of anus and *JV5* which are longer.

Table 5 Comparisons of character measurements of female specimens of *Neoseiulus longispinosus* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	Grande Comore (8)	Martinique (8)	F.C.I. (7)	Sri Lanka (3)	Holotype
Dsl	**380**	321 (295-340)	332 (308-398)	321 (313–338)	332
Dsw	**192**	168 (150-183)	179 (154-200)	187 (175–208)	173
j1	**20**	16 (13-18)	18 (16-22)	18 (17–19)	14
j3	**69**	58 (48-63)	59 52-64)	62 (61–64)	51
j4	**70**	56 (50-65)	59 (52-65)	58 (56–60)	49
j5	**78**	66 (60-73)	69 (64-75)	70 (69–71)	59
j6	**78**	68 (60-83)	72 (68-75)	70 (68–72)	64
J2	**88**	76 (68-88)	76 (73-78)	77 (75–79)	66
J5	**10**	9 (8-10)	9 (8-11)	8	10
z2	**75**	64 (58-70)	65 (62-68)	69 (68–70)	58
z4	**78**	70 (63-87)	69 (67-73)	73 (73–75)	58
z5	**38**	31 (28-35)	35 (32-40)	32 (32–38)	nr
Z1	**83**	74 (68-80)	75 (72-80)	77 (76–78)	67
Z4	**78**	69 (63-78)	71 (67-75)	72 (71–73)	68
Z5	**85**	77 (65-80)	80 (78-81)	80 (80–81)	72
s4	**?**	78 (73-88)	77 (73-80)	82 (80–83)	75
S2	**88**	69 (63-76)	72 (68-76)	73 (70–79)	67
S4	**63**	52 (45-58)	57 (48-76)	59 (57–62)	49
S5	**18**	14 (13-15)	16 (14-16)	21 (19–23)	15
r3	**75**	54 (45-63)	57 (49-62)	55 (55–56)	54
R1	**70**	57 (50-63)	61 (57-65)	60 (59–62)	58
St1-St1	**48**	46 (45-50)	Not reported	Not reported	nr
St1-St3	**55**	54 (53-55)	55 (49-57)	55 (53–56)	nr
St2-St2	**60**	58 (55-60)	60 (59-62)	53 (50–55)	nr
St3-St3	**73**	70 (68-73)	Not reported	Not reported	nr
St4-St4	**85**	72 (63-88)	Not reported	Not reported	nr
St5-St5	**58**	53 (50-63)	56 (52-60)	53 (51–54)	nr
Lisl	**23**	28 (23-33)	Not reported	Not reported	nr
Lsiw	**3**	3	Not reported	Not reported	nr
Sisl	**18**	13 (10-15)	Not reported	Not reported	nr
Vsl	**125**	111 (103-120)	115 (94-121)	106 (103–111)	97
vsw *ZV2*	**90**	84 (75-90)	86 (80-92)	91 (89–93)	87
vsw anus	**78**	70 (65-75)	75 (67-83)	75 (73–77)	nr
JV5	**73**	60 (55-63)	Not reported	Not reported	nr
StIV	**75**	81 (75-88)	80 (75-87)	68 (68–70)	80-87
Scl	**25**	20 (17-25)	28 (25-30)	21 (20–21)	30
Scw	**5**	5	Not reported	Not reported	4
Fdl	**23**	24 (23-25)	25 (22-27)	22 (21–22)	**nr**
teeth	***?***	***4***	***4-5***	***5***	
Mdl	**23**	24 (23-25)	24 (22-25)	25 (23–25)	***2***
teeth	***?***	***2***	***1-2***	***2***	

Data from this study for Grande Comore, from Kreiter *et al.* (2018) for Martinique, from Moraes *et al.* (2000) for F.C.I (French Caribbean Islands, from various localities of five Islands), from Moraes *et al.* (2004) for Sri Lanka, and from Evans (1952) for the holotype from Indonesia, re-described by Schicha (1975). nr = not reported.

Subfamily Phytoseiinae Berlese

Phytoseiini Berlese, 1913: 3; Phytoseiinae, Vitzthum, 1941: 768.

Genus *Phytoseius* Ribaga

Phytoseius Ribaga, 1904: 177.

Phytoseius amba Pritchard & Baker

Phytoseius (*Pennaseius*) *amba* Pritchard & Baker 1962: 224; Blommers, 1976: 85;
Phytoseius (*Phytoseius*) *amba*, Denmark, 1966: 49;
Typhlodromus (*Pizytoseius*) *amba*, Van der Merwe, 1968: 101;
Phytoseius amba, Swirski & Ragusa, 1978: 408;
Pennaseius amba, Matthysse & Denmark, 1981: 352;
Phytoseius amba, Moraes *et al.*, 1986: 210; 2004: 232; Chant & McMurtry, 2007: 129.

Species of the genus *Phytoseius* are supposed to belong to the Type III species (McMurtry and Croft 1997; McMurtry *et al.* 2013), *i.e.* a polyphagous generalist predator. However, the biology of *Phytoseius amba* remains totally unknown.

Specimens examined — **Mdé**, INRAPE (long. 11°41′S, lat. 43°14′E, alt. 50 m), 1 ♀ on *Annona muricata* L. (Annonaceae), 2-02-2017.

Previous Records — Benin, Burundi, Cameroon, Cape Verde, DR Congo, Kenya, Madagascar Island, Malawi, Mozambique, Nigeria, Reunion Island, Rwanda, Senegal, South Africa, Zambia, Zimbabwe.

Remarks (Table 6) — The setae lengths seem very variable in this species following data of the literature. Measurements of the single adult female (Table 6) agree well with measurements of the literature, especially with those of Ueckermann *et al.* (2007) obtained with a great number of specimens (29) from various countries in Africa, with the exception of longer *j3* and *z3*, shorter st5-st5, ventrianal shield length and width at the level of anus and macrosetae of the basitarsus and telotarsus.

Conclusion

Only one species was known before 2017 from the Comoros Archipelago (Schicha 1984). After this preliminary survey conducted in only two locations, the number of species known from Comoros Islands is now of six; four Amblyseiinae: *Amblyseius herbicolus*, *Euseius baetae*, *Iphiseius degenerans*, *Neoseiulus longispinosus*; and two Phytoseiinae: *Phytoseius amba* and *Phytoseius mayottae*. No Typhlodrominae were found until now. This is still a low number of species and from a tropical island, one could have expected a higher number, even from only two locations. The low number of species could be explained by the fact that samplings were made in crops more or less disturbed and not in wild areas.

Some of the species collected during this survey have interesting potential for biological control, especially *A. herbicolus, I. degenerans* and *N. longispinosus*. This must be underlined as new regulations on importation of macro-organisms are proposed in a lot of countries and specifically for over-sea territories for countries like France that have very far tropical territories. Therefore it is impossible to import and of course to sell and use exotic species if they are not indigenous in the territory. An importation permit must be requested, but it is expensive and chances to obtain are generally very low (Kreiter *et al.* 2016). The knowledge of the biodiversity, especially of efficient biological control agents from oversea territories,

Table 6 Comparisons of character measurements of female specimens of *Phytoseius amba* collected in different locations (Localities followed by the number of specimens measured between brackets)

Characters	**Grande Comore** (1)	**South Africa** (11)	**Various Countries** (29)	**Madagascar** (6)	**Kenya** (8)	**Holotype**
Dsl	270	264-284	282 (264-304)	Not reported	288 (271-312)	283
Dsw	155	130-145	141 (133-149)	Not reported	144 (139-149)	165
j1	23	24-26	22 (19-27)	19-25	24 (22-26)	24
j3	63	46-50	49 (40-56)	50-56	50 (41-60)	42
j4	5	7	4 (3-5)	nr	4 (2-5)	3
j5	5	7	4 (3-5)	nr	4 (2-5)	3
j6	6	7	5 (3-6)	nr	5 (2-7)	4
J2	9	9-11	6 (5-8)	nr	5	6
J5	8	11-14	10 (8-13)	nr	11 (10-12)	11
z2	13	9-11	7 (5-10)	nr	7 (5-10)	5
z3	43	26-29	23 (16-27)	19-31	24 (19-29)	17
z4	10	9-11	8 (5-11)	nr	8 (5-12)	5
z5	5	7	4 (3-5)	nr	5 (2-5)	5
Z4	63	60-80	62 (48-70)	59-65	62 (55-67)	64
Z5	70	57-80	76 (59-86)	64-77	75 (67-82)	83
s4	89	70-85	81 (53-102)	78-82	76 (70-86)	81
s6	75	60-80	77 (48-96)	71-78	78 (67-86)	79
r3	39	37-45	40 (34-46)	37-44	39 (34-43)	41
R1	15	12-16	13 (10-16)	Not reported	14 (12-17)	12
St1-St1	68	50-60	Not reported	Not reported	Not reported	nr
St1-St3	58	68-75	60 (56-64)	Not reported	59 (53-60)	60
St2-St2	63	Not reported	69 (64-72)	Not reported	70 (67-72)	79
St3-St3	68	Not reported	Not reported	Not reported	Not reported	Nr
St4-St4	73	Not reported	Not reported	Not reported	Not reported	Nr
St5-St5	55	67-72	67 (62-74)	Not reported	69 (67-72)	63
Lisl	18	Not reported	Not reported	Not reported	Not reported	nr
Lsiw	2	Not reported	Not reported	Not reported	Not reported	nr
Sisl	8	Not reported	Not reported	Not reported	Not reported	nr
Vsl	83	90-98	99 (86-106)	Not reported	99 (84-108)	100
vsw *ZV2*	48	48-55	55 (50-64)	Not reported	60 (55-67)	53
vsw anus	38	Not reported	49 (43-56)	Not reported	49 (48-53)	46
JV5	45	45-51	Not reported	54	Not reported	nr
SgeIV	25	24-28	25 (19-32)	23-27	26 (24-34)	21
StiIV	25	30-35	34 (26-40)	30-36	33 (29-38)	31
SbtIV	23	33-38	35 (27-43)	30-34	33 (26-43)	39
SttIV	23	26-30	32 (28-38)	28-32	Not reported	36
Scl	18	16-18	13 (8-19)	Not reported	20 (17-24)	12
Scw	10	4-7	Not reported	Not reported	Not reported	nr
fdl	23	24	25 (23-26)	Not reported	20 (17-24)	17
teeth	***1***	***2***	2-3		***nr***	***nr***
mdl	23	24	25 (23-26)	Not reported	24	17
teeth	***1***	***1***	1-2		***nr***	***1***

Data from this paper for Grande Comore, from Van der Merwe (1968) for South Africa, from Ueckermann *et al.* (2007) for various countries (Burundi 8, Cameroon 1, Ghana 2, Kenya 5, Rwanda 7, Sierra Leone 1, South Africa 4, Democratic Republic of Congo 1) in Africa, from Blommers (1976) for Madagascar, from Moraes *et al.* (1989) for Kenya and measurements of the holotype. nr = not reported.

not only for conversation purposes but also for agricultural and economical ones, is so of a considerable importance.

Acknowledgements

Thanks are due to Mr. Hadji MOUIGNI (from INRAPE) who has helped Jacques Fillâtre (Armeflhor) to collect mites in Grande Comore Island and the two anonymous reviewers for improvement of the paper.

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